

SMART Bandage for Monitoring Wound Perfusion

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Description:

OBJECTIVE: Develop and demonstrate an innovative wound dressing that quantitatively reports tissue perfusion for monitoring and optimizing wound healing. **DESCRIPTION:** The current standard-of-care for wounds and grafts relies on subjective observations of tissue health that are episodic and can vary greatly between caregivers with different degrees of training (1). For example, measurements of tissue perfusion, a critical parameter necessary for wound and graft healing, currently rely on qualitative assessments of wound healing, including tissue color, temperature, capillary refill and smell. This lack of quantitative tissue oxygenation information can lead to poor outcomes; without accurate knowledge of tissue perfusion, thermal burn sites, for example, may be inadequately debrided, leading to subsequent graft failure with accompanying aesthetic and functional consequences (2). This lack of operator-independent, quantitative and non-episodic perfusion monitoring of wounds, grafts and flaps (3) has been recognized as a major unmet need for our wounded warriors. Current oxygen sensing tools rely on fragile probes that require extensive training to use correctly, provide only point measurements, and are not easily integrated into battlefield or surgical settings. Problematically, current wound assessment and therapeutic methods require the removal of dressings, resulting in further disruptions to the surgical site or wound bed that can lead to discomfort, compromised healing and complications. New objective approaches for monitoring and treating wounds are needed to improve surgical outcome and wound healing for both military personnel and civilians. To address these needs, a transparent wound dressing will be developed that provides real-time maps of tissue oxygenation and other parameters across entire wounds, surgical beds or burn sites for direct, continuous monitoring of tissue health throughout the healing process. A potential approach to this development is to build upon the research described in

reference (4). A further development aim of this topic, to eliminate the need for dressing removal during treatment, is a therapeutic release system integrated into the bandage for interactive, spatio-specific delivery of drugs directly to vulnerable tissues. This Sensing, Monitoring, And Release of Therapeutics (SMART) bandage system could then be used for post-treatment wound monitoring to provide caregivers with a continuous, quantitative read-out of treatment response and wound healing. PHASE I: Develop, refine and demonstrate an oxygen sensing bandage that incorporates an oxygen sensing layer removed from direct tissue contact, and a semi-permeable barrier layer that buffers the sensing layer from room oxygen. PHASE II: Based on Phase I results, develop and test a clinical prototype system consisting of the oxygen sensing bandage, an optical imaging device, and software algorithms that will integrate the two and enable quantitative mapping of wound-healing parameters. Also in this phase, create the initial design specifications for prototyping the therapeutic release capability within the bandage. PHASE III DUAL USE APPLICATIONS: The focus in Phase III will be to conduct human studies of a fully integrated oxygen sensing and monitoring system in both battlefield and civilian settings, and to integrate the prototype therapeutic release capability into the bandage system.